

इंटरनेट

मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 3708-8 (2005): Methods of Test for Natural Rubber Latex, Part 8: Determination of Total Nitrogen [PCD 13: Rubber and Rubber Products]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE



भारतीय मानक

प्राकृतिक रबड़ लेटैक्स की परीक्षण पद्धतियाँ

भाग 8 रबड़, कच्चा प्राकृतिक और रबड़ लेटैक्स,

प्राकृतिक — नाइट्रोजन का अंश ज्ञात करना

(दूसरा पुनरीक्षण)

Indian Standard

METHODS OF TEST FOR NATURAL RUBBER LATEX

PART 8 RUBBER, RAW NATURAL AND RUBBER LATEX,
NATURAL — DETERMINATION OF NITROGEN CONTENT

(*Second Revision*)

ICS 83.040.10

© BIS 2005

BUREAU OF INDIAN STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG

NEW DELHI 110002

NATIONAL FOREWORD

This Indian Standard (Part 8) (Second Revision) which is identical with ISO 1656 : 1996 ‘Rubber, raw natural and rubber latex, natural — Determination of nitrogen content’ issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendations of the Rubber and Rubber Products Sectional Committee and approval of the Petroleum, Coal and Related Products Division Council.

The text of ISO Standard has been proposed to be approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words ‘International Standard’ appear referring to this standard, they should be read as ‘Indian Standard’.
- b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

The Technical Committee responsible for the preparation of this standard has reviewed the provisions of the following International Standards and decided that they are acceptable for use in conjunction with this standard:

| <i>International Standard</i> | <i>Title</i> |
|-------------------------------|--------------------------------------------------------------------------------------|
| ISO 123 : 2001 | Rubber latex — Sampling |
| ISO 124 : 1997 | Latex, rubber — Determination of total solids content |
| ISO 1795 : 2000 | Rubber, raw, natural and raw synthetic — Sampling and further preparative procedures |

Indian Standard

METHODS OF TEST FOR NATURAL RUBBER LATEX

PART 8 RUBBER, RAW NATURAL AND RUBBER LATEX,
NATURAL — DETERMINATION OF NITROGEN CONTENT

(*Second Revision*)

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

This International Standard specifies a macro-method and a semi-micro method for the determination of nitrogen in raw natural rubber and in natural rubber latex using variants of the Kjeldahl process.

NOTE 1 The determination of nitrogen in natural rubber is usually carried out in order to arrive at an estimate of the protein content. Minor amounts of non-proteinous nitrogen-containing constituents are also present, however, and in the dry solids prepared from natural rubber latex these materials can make a substantial contribution to the total nitrogen content.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 123:1985, *Rubber latex — Sampling*.

ISO 124:1992, *Rubber latices — Determination of total solids content*.

ISO 1795:1992, *Rubber, raw, natural and synthetic — Sampling and further preparative procedures*.

ISO/TR 9272:1986, *Rubber and rubber products — Determination of precision for test method standards*.

3 Principle

A known mass of the sample is digested with a mixture of sulfuric acid, potassium sulfate, and catalytic amounts of copper sulfate and selenium or sodium selenate, thereby converting nitrogen compounds into ammonium hydrogen sulfate from which the ammonia is distilled after making the mixture alkaline.

The distilled ammonia is absorbed

- either in standard volumetric sulfuric acid solution followed by titration of the excess acid with a standard volumetric base solution;
- or in boric acid solution followed by titration with standard volumetric acid solution (as boric acid is a weak acid, it does not affect the indicator used for this titration).

4 Macro-method

4.1 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

4.1.1 Catalyst mixture or catalyst solution.

CAUTION — When working with selenium, avoid breathing vapours and/or contact with skin or clothing. Work only with adequate ventilation.

4.1.1.1 Catalyst mixture

Prepare a finely divided intimate mixture of

- 30 parts by mass of anhydrous potassium sulfate (K_2SO_4);
- 4 parts by mass of copper sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$);
- 1 part by mass of selenium powder, or 2 parts by mass of sodium selenate decahydrate ($Na_2SeO_4 \cdot 10H_2O$).

4.1.1.2 Catalyst solution

Dissolve, with heating,

- 110 g of anhydrous potassium sulfate,
 - 14,7 g of copper sulfate pentahydrate,
 - 3,7 g of selenium, or 7,49 g of sodium selenate,
- in 600 cm³ of sulfuric acid (4.1.2).

4.1.2 Sulfuric acid, ρ 1,84 g/cm³.

4.1.3 Sulfuric acid, standard volumetric solution, $c(H_2SO_4) = 0,05$ mol/dm³.

4.1.4 Sodium hydroxide, standard volumetric solution, $c(NaOH) = 0,1$ mol/dm³.

4.1.5 Sodium hydroxide, solution, $c(NaOH) \approx 10$ mol/dm³.

Dissolve 400 g of solid sodium hydroxide in 600 cm³ of water.

4.1.6 Boric acid, solution, $c(H_3BO_3) \approx 0,17$ mol/dm³.

Dissolve 40 g of solid boric acid in 1 dm³ of water, warming if necessary, and cool the solution to room temperature.

4.1.7 Mixed indicator, solution.

Dissolve 0,1 g of methyl red and 0,05 g of methylene blue in 100 cm³ of 96 % (V/V) ethanol.

This indicator may deteriorate during storage and shall therefore be freshly prepared.

4.2 Apparatus

Ordinary laboratory apparatus and

Kjeldahl apparatus, with a digestion flask of capacity 800 cm³.

4.3 Sampling and preparation of test portion

For the determination of nitrogen in raw solid rubber, a test portion shall be taken from the homogenized piece, sampled and prepared in accordance with ISO 1795.

For the determination of nitrogen in latex, a representative portion (see ISO 123) of thoroughly mixed latex containing about 2 g of total solids shall be dried to constant mass as specified in ISO 124.

4.4 Procedure

4.4.1 Cut about 2 g of the rubber or dried latex, weighed to the nearest 0,5 mg, into small pieces and place in the digestion flask (see 4.2). Add about 13 g of the catalyst mixture (4.1.1.1) and 60 cm³ of the sulfuric acid (4.1.2), or, alternatively, 65 cm³ of the catalyst solution (4.1.1.2). Mix the contents of the flask by swirling, and then boil gently until the solution is clear. Continue boiling for a further 1 h.

Allow the digestion flask and its contents to cool to room temperature, cautiously add 200 cm³ of water and mix by swirling.

Place the receiving flask containing the absorbing solution in position, connect the distillation unit, then slowly add 150 cm³ of the sodium hydroxide solution (4.1.5) to the digestion flask from a dropping funnel.

4.4.2 Carry out the absorption and titration of the liberated ammonia by the procedure described in 4.4.2.1 or 4.4.2.2. The temperature of the receiving flask shall be maintained below 30 °C to prevent any loss of ammonia.

4.4.2.1 Place 75 cm³ of water and, by means of a pipette, 25 cm³ of the standard volumetric sulfuric acid solution (4.1.3) in the receiving flask of the distillation unit, together with two drops of mixed indicator solution (4.1.7). Position the receiving flask so that the end of the delivery tube from the condenser dips below the surface of the absorbing solution. While holding the stopper of the digestion flask in place, thoroughly mix the contents by swirling. Immediately commence distillation and continue at a steady rate until 200 cm³ of distillate have been collected. If the colour of the indicator changes, indicating alkalinity of the absorbing solution, discontinue the determination and repeat the procedure using more sulfuric acid or a smaller test portion.

When the distillation is complete (normally when the volume in the flask reaches about 300 cm³), titrate the contents with the sodium hydroxide solution (4.1.4), reading the burette to the nearest 0,02 cm³.

4.4.2.2 Place 100 cm³ of the boric acid solution (4.1.6) in the receiving flask of the distillation unit with two drops of the mixed indicator solution (4.1.7). Carry out the distillation as described in 4.4.2.1 and titrate the distillate with the sulfuric acid solution (4.1.3), reading the burette to the nearest 0,02 cm³.

4.5 Blank test

In parallel with the determination, carry out a blank test using the same quantities of reagents under the same operating conditions, but omitting the test portion.

4.6 Expression of results¹⁾

4.6.1 When sulfuric acid is used as the absorbing solution as specified in 4.4.2.1, the nitrogen content of the rubber, expressed as a percentage by mass, is given by the formula

$$\frac{0,14(V_2 - V_1)}{m}$$

where

V_1 is the volume, in cubic centimetres, of sodium hydroxide solution (4.1.4) required for the titration;

V_2 is the volume, in cubic centimetres, of sodium hydroxide solution (4.1.4) required for the titration in the blank test;

m is the mass, in grams, of the test portion.

Express the result to the nearest 0,01 %.

4.6.2 When boric acid is used as the absorbing solution as specified in 4.4.2.2, the nitrogen content of the rubber, expressed as a percentage by mass, is given by the formula

$$\frac{0,14(V_3 - V_4)}{m}$$

where

V_3 is the volume, in cubic centimetres, of sulfuric acid solution (4.1.3) required for the titration;

V_4 is the volume, in cubic centimetres, of sulfuric acid solution (4.1.3) required for the titration in the blank test;

m is the mass, in grams, of the test portion.

Express the result to the nearest 0,01 %.

5 Semi-micro method

5.1 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

5.1.1 Catalyst mixture.

CAUTION — When working with selenium, avoid breathing vapours and/or contact with skin or clothing. Work only with adequate ventilation.

Prepare a finely divided intimate mixture of

- 30 parts by mass of anhydrous potassium sulfate (K₂SO₄);
- 4 parts by mass of copper sulfate pentahydrate (CuSO₄·5H₂O);
- 1 part by mass of selenium powder, or 2 parts by mass of sodium selenate decahydrate (Na₂SeO₄·10H₂O).

5.1.2 Sulfuric acid, ρ 1,84 g/cm³.

5.1.3 Sulfuric acid, standard volumetric solution, $c(\text{H}_2\text{SO}_4) = 0,01 \text{ mol/dm}^3$.

5.1.4 Sodium hydroxide, solution, $c(\text{NaOH}) \approx 10 \text{ mol/dm}^3$.

Dissolve 400 g of solid sodium hydroxide in 600 cm³ of water.

5.1.5 Sodium hydroxide, standard volumetric solution, $c(\text{NaOH}) = 0,02 \text{ mol/dm}^3$, carbonate-free.

5.1.6 Boric acid, solution, $c(\text{H}_3\text{BO}_3) \approx 0,17 \text{ mol/dm}^3$.

Dissolve 40 g of solid boric acid in 1 dm³ of water, warming if necessary, and cool the solution to room temperature.

1) If the concentrations of the standard volumetric solution used are not exactly as specified in the list of reagents, appropriate corrections should be made.

5.1.7 Mixed indicator, solution.

Dissolve 0,1 g of methyl red and 0,05 g of methylene blue in 100 cm³ of 96 % (V/V) ethanol.

This indicator may deteriorate during storage and shall therefore be freshly prepared.

5.2 Apparatus

Ordinary laboratory apparatus and

5.2.1 Semi-micro Kjeldahl digestion apparatus, with digestion flasks of capacity 30 cm³ and 10 cm³ (for an example of a typical apparatus, see figures 1, 2 and 3).

5.2.2 Semi-micro Kjeldahl distillation unit, with a condenser tube of silver, borosilicate glass or tin (for an example, see figures 4 to 9).

5.2.3 Semi-micro burette, of capacity 5 cm³ or 10 cm³, graduated in 0,02 cm³ divisions.

5.3 Sampling and preparation of test portion

For the determination of nitrogen in raw solid rubber, a test portion shall be taken from the homogenized piece, sampled and prepared in accordance with ISO 1795.

For the determination of nitrogen in latex, a representative portion (see ISO 123) of thoroughly mixed latex containing about 0,1 g of total solids shall be dried to constant mass as specified in ISO 124.

5.4 Procedure

5.4.1 Weigh, to the nearest 0,1 mg, 0,1 g to 0,2 g of the rubber or dried latex and place in a digestion flask (see 5.2.1). Add about 0,65 g of the catalyst mixture (5.1.1) and 3,0 cm³ of the sulfuric acid (5.1.2) and heat the contents carefully to the boiling point. Continue boiling for a further 30 min after the digest has become clear and green with no yellow tint.

Avoid excess boiling, as indicated by a tendency for the digest to solidify on cooling, since this may lead to loss of nitrogen.

Bring the water in the steam generator of the distillation unit to the boil and pass steam through the distillation apparatus (5.2.2), including the receiving flask, for at least 2 min. The water-jacket of the condenser shall be empty of water during the steaming-out operation. Meanwhile, cool the digestion flask to room

temperature or below, add 10 cm³ of water and immediately transfer the contents to the distillation flask at the conclusion of the steaming-out process. Complete the transfer by rinsing three times with 3 cm³ portions of water and draining the flask thoroughly after each transfer.

5.4.2 Discard any condensate which has collected in the receiver and complete the distillation and titration of ammonia by the procedure described in 5.4.2.1 or 5.4.2.2. The temperature of the receiving flask shall be maintained below 30 °C to prevent loss of ammonia.

5.4.2.1 Add from the semi-micro burette (5.2.3) to the steamed-out receiver of the distillation apparatus a measured volume of sulfuric acid solution (5.1.3), using at least 5 cm³ (the exact volume depending on the amount of nitrogen expected), together with two drops of the mixed indicator solution (5.1.7) and about 5 cm³ of water. Position the receiver so that the end of the delivery tube from the condenser dips below the surface of the acid. It is an advantage to tilt the receiver slightly to gain a greater depth of liquid.

Add approximately 15 cm³ of the sodium hydroxide solution (5.1.4) to the distillation flask by means of a measuring cylinder, and pass steam from the generator through the distillation flask for 10 min to 12 min at such a rate that the final volume of liquid in the receiver is about 70 cm³. If the colour of the indicator changes, indicating alkalinity of the absorbing solution, discontinue the determination and repeat the procedure using more sulfuric acid or a smaller test portion.

When the distillation is complete, lower the receiving flask until the tip of the condenser is above the level of the acid, continue the distillation for another 1 min, and then rinse the tip of the condenser tube with a few cubic centimetres of water which shall be collected in the distillate. Immediately titrate the contents of the receiving flask with the sodium hydroxide solution (5.1.5), reading the burette to the nearest 0,02 cm³.

5.4.2.2 Place about 10 cm³ of the boric acid solution (5.1.6) in the steamed-out receiving flask with two drops of the mixed indicator solution (5.1.7). Carry out the distillation as described in 5.4.2.1, but note that, in the presence of boric acid, the indicator colour should change immediately distillation of ammonia commences. Titrate the distillate with sulfuric acid solution (5.1.3), reading the burette to the nearest 0,02 cm³.

5.5 Blank test

In parallel with the determination, carry out a blank test using the same quantities of reagents under the same operating conditions, but omitting the test portion.

5.6 Expression of results²⁾

5.6.1 When sulfuric acid is used as the absorbing solution as specified in 5.4.2.1, the nitrogen content of the rubber, expressed as a percentage by mass, is given by the formula

$$\frac{0,028(V_2 - V_1)}{m}$$

where

V_1 is the volume, in cubic centimetres, of sodium hydroxide solution (5.1.5) required for the titration;

V_2 is the volume, in cubic centimetres, of sodium hydroxide solution (5.1.5) required for the titration in the blank test;

m is the mass, in grams, of the test portion.

Express the result to the nearest 0,01 %.

5.6.2 When boric acid is used as the absorbing solution as specified in 5.4.2.2, the nitrogen content of the rubber, expressed as a percentage by mass, is given by the formula

$$\frac{0,028(V_3 - V_4)}{m}$$

where

V_3 is the volume, in cubic centimetres, of sulfuric acid solution (5.1.3) required for the titration;

V_4 is the volume, in cubic centimetres, of sulfuric acid solution (5.1.3) required for the titration in the blank test;

m is the mass, in grams, of the test portion.

Express the result to the nearest 0,01 %.

6 Precision

6.1 General

The precision calculations to express repeatability and reproducibility were performed in accordance with ISO/TR 9272. Consult this Technical Report for precision concepts and nomenclature. Annex A of this International Standard gives guidance on the use of repeatability and reproducibility.

2) If the concentrations of the standard volumetric solutions used are not exactly as specified in the list of reagents, appropriate corrections should be made.

6.2 Precision details

6.2.1 An interlaboratory test programme was organized in late 1984 by the Rubber Research Institute of Malaysia. Two separate programmes were conducted, one in March and one in July. Two types of material were sent to each laboratory:

- blended samples of two rubbers "A" and "B";
- unblended (normal) samples of the same two materials "A" and "B".

6.2.2 For both the blended and the unblended samples, a test result was taken as the mean of three separate determinations.

6.2.3 The semi-micro method was used to determine the nitrogen content.

6.2.4 A "type 1" precision was measured in the interlaboratory test programme. The time period for repeatability and reproducibility was on a scale of days. A total of 14 laboratories participated in the programme for blended samples and a total of 13 laboratories in the programme for unblended samples.

6.3 Precision results

The precision results for the blended-sample programme are given in table 1 and the results for the unblended-sample programme in table 2.

7 Test report

The test report shall include the following information:

- a reference to this International Standard and the method used;
- all details necessary for the identification of the material tested;
- the results and the units in which they are expressed;
- any unusual features noted during the determination;
- any operation not included in this International Standard or in the International Standards to which reference is made, and any operation regarded as optional;
- the date of the test.

Table 1 — Type 1 precision — Blended-sample testing

| Rubber sample | Average nitrogen content % (m/m) | Within-laboratory repeatability | | Interlaboratory reproducibility | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---------------------------------|--------------|---------------------------------|--------------|
| | | <i>r</i> | (<i>r</i>) | <i>R</i> | (<i>R</i>) |
| A | 0,45 | 0,053 | 11,7 | 0,094 | 20,9 |
| B | 0,53 | 0,024 | 4,45 | 0,161 | 30,2 |
| Pooled values | 0,49 | 0,042 | 8,42 | 0,127 | 25,6 |
| <i>r</i> = repeatability, in percent by mass (<i>r</i>) = repeatability, in percent (relative) of the average <i>R</i> = reproducibility, in percent by mass (<i>R</i>) = reproducibility, in percent (relative) of the average | | | | | |

Table 2 — Type 1 precision — Unblended-sample testing

| Rubber sample | Average nitrogen content % (m/m) | Within-laboratory repeatability | | Interlaboratory reproducibility | |
|-------------------------------------|-------------------------------------|---------------------------------|--------------|---------------------------------|--------------|
| | | <i>r</i> | (<i>r</i>) | <i>R</i> | (<i>R</i>) |
| A | 0,36 | 0,021 | 5,83 | 0,189 | 52,7 |
| B | 0,36 | 0,038 | 10,82 | 0,185 | 51,9 |
| Pooled values | 0,36 | 0,031 | 8,67 | 0,187 | 52,4 |
| See table 1 for symbol definitions. | | | | | |

Dimensions in millimetres³⁾

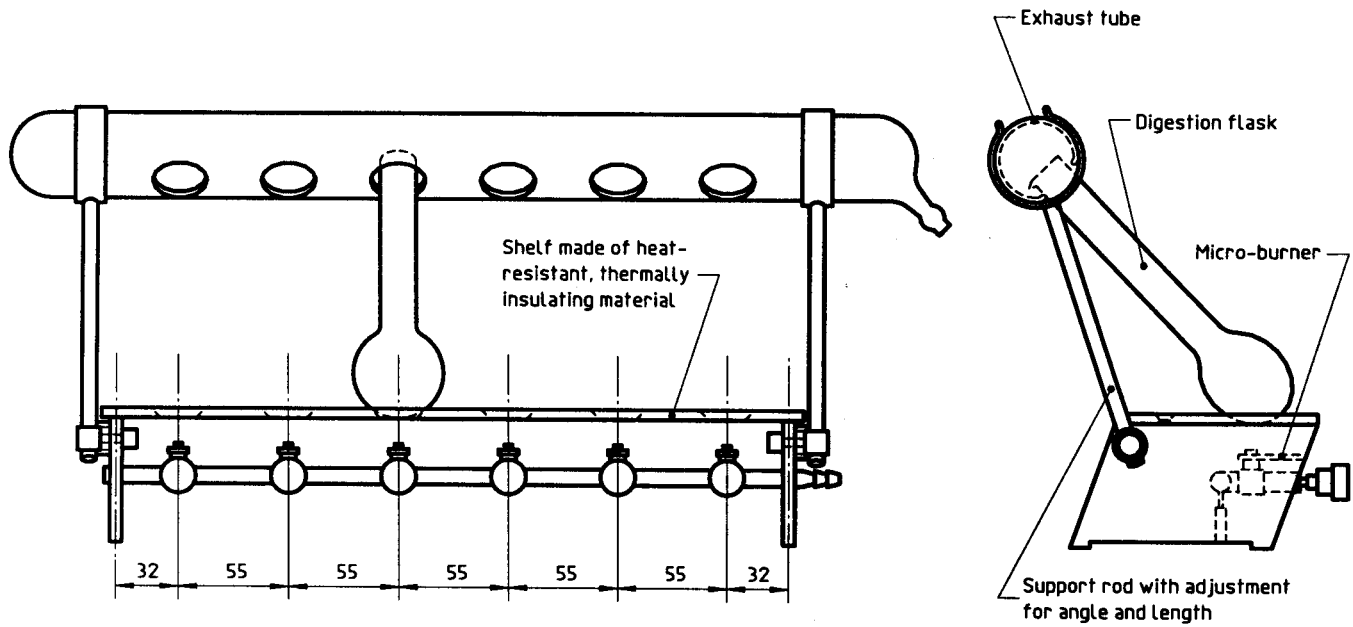


Figure 1 — Assembly of digestion apparatus for the semi-micro method

Dimensions in millimetres³⁾

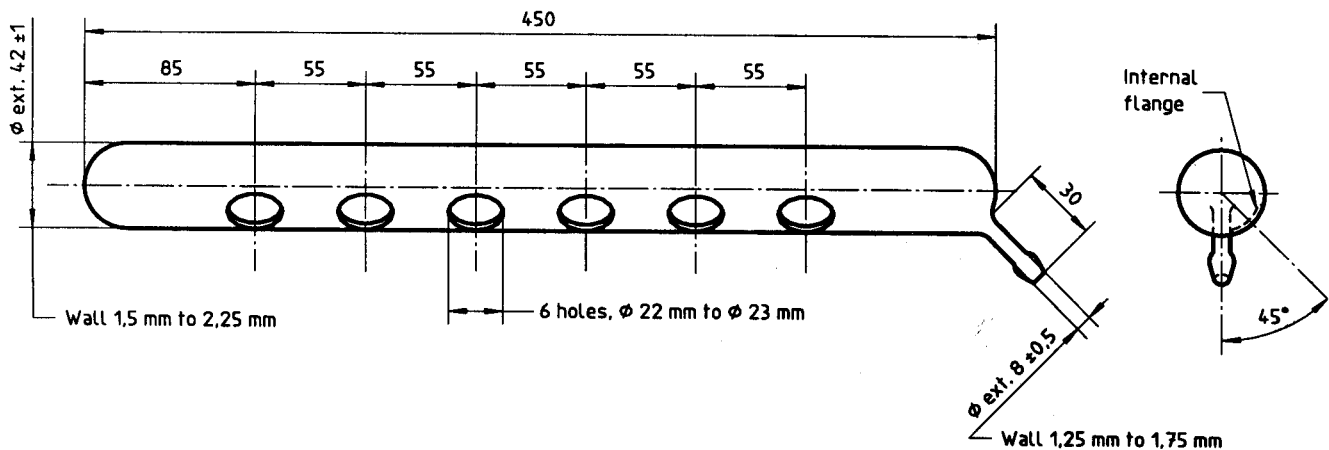


Figure 2 — Exhaust tube for the semi-micro method

3) Where no tolerances are shown, normal working tolerances are allowed.

Dimensions in millimetres⁴⁾

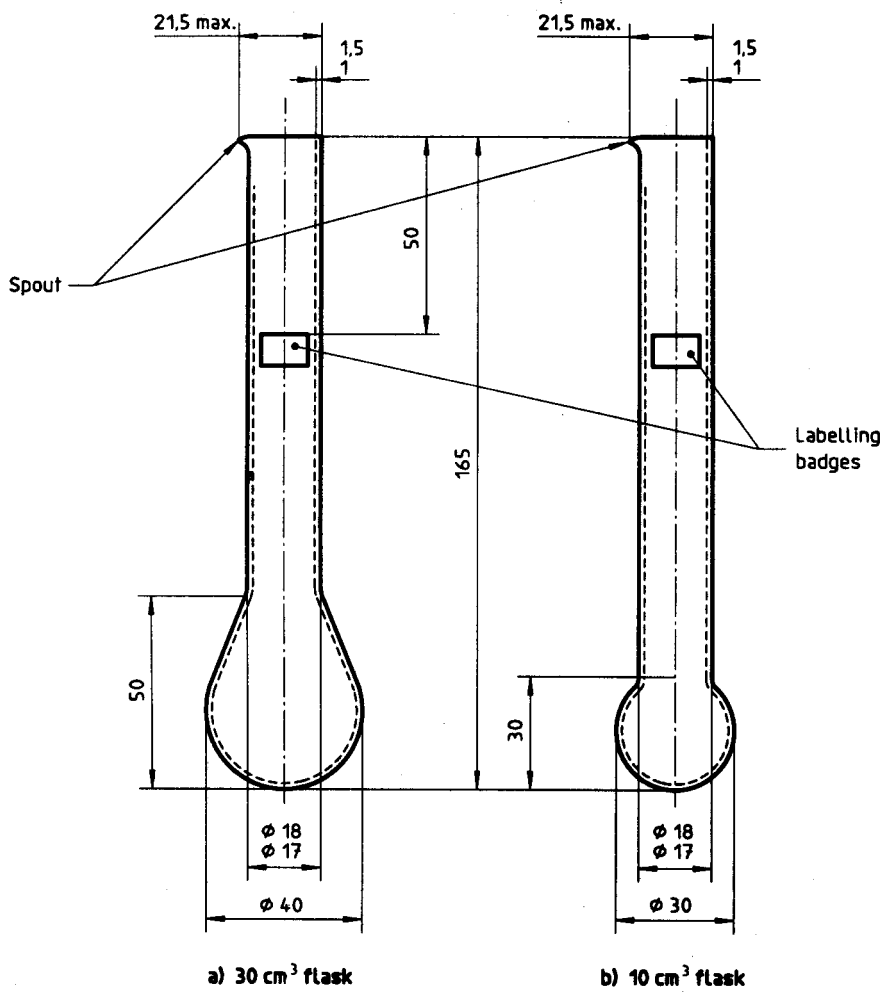
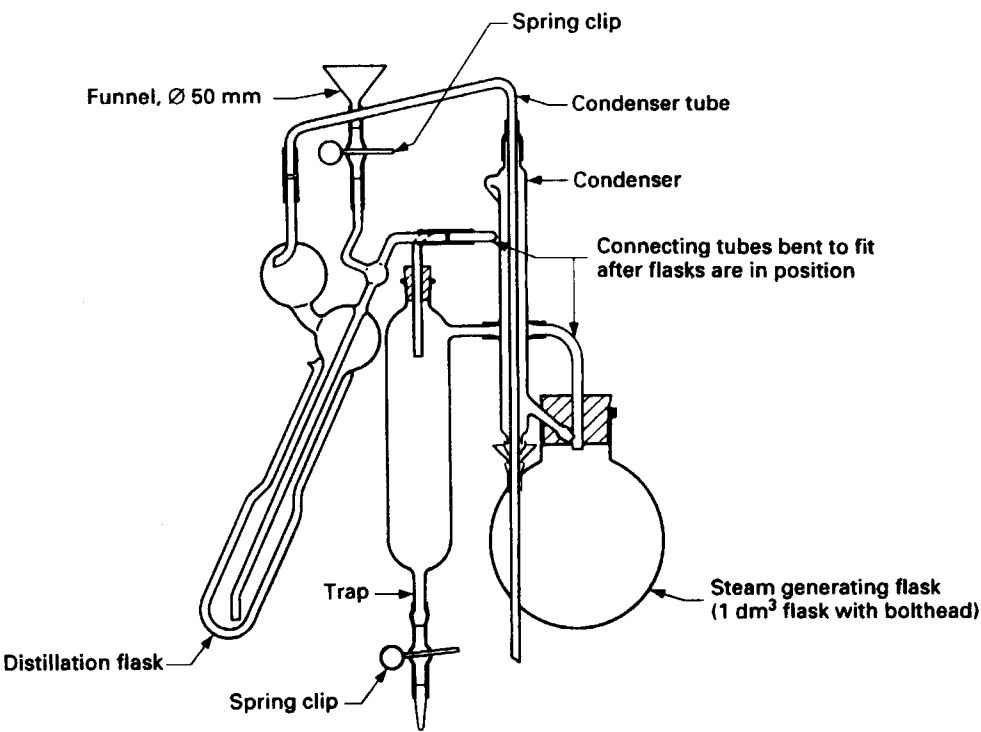
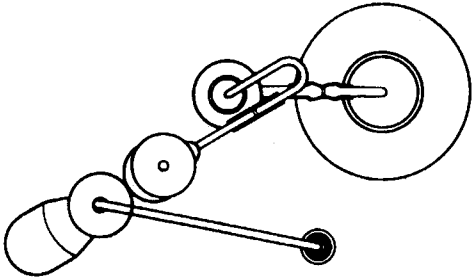


Figure 3 — Digestion flasks for the semi-micro method

4) Where no tolerances are shown, normal working tolerances are allowed.



Elevation
(Three-quarter view as indicated by plan below)



Plan

Figure 4 — Assembly of distillation apparatus for the semi-micro method

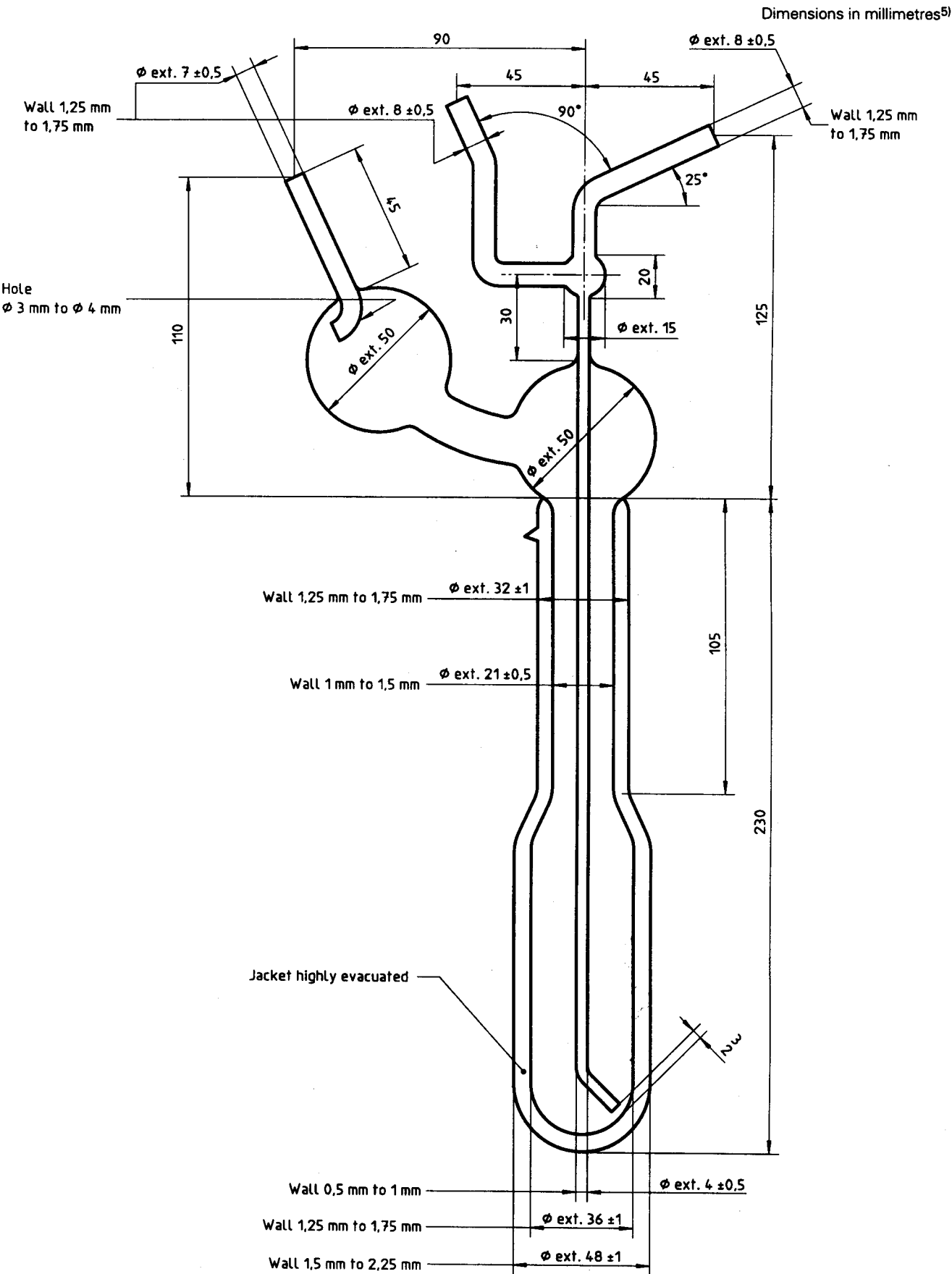


Figure 5 — Distillation flask for the semi-micro method

5) Where no tolerances are shown, normal working tolerances are allowed.

Dimensions in millimetres⁶⁾

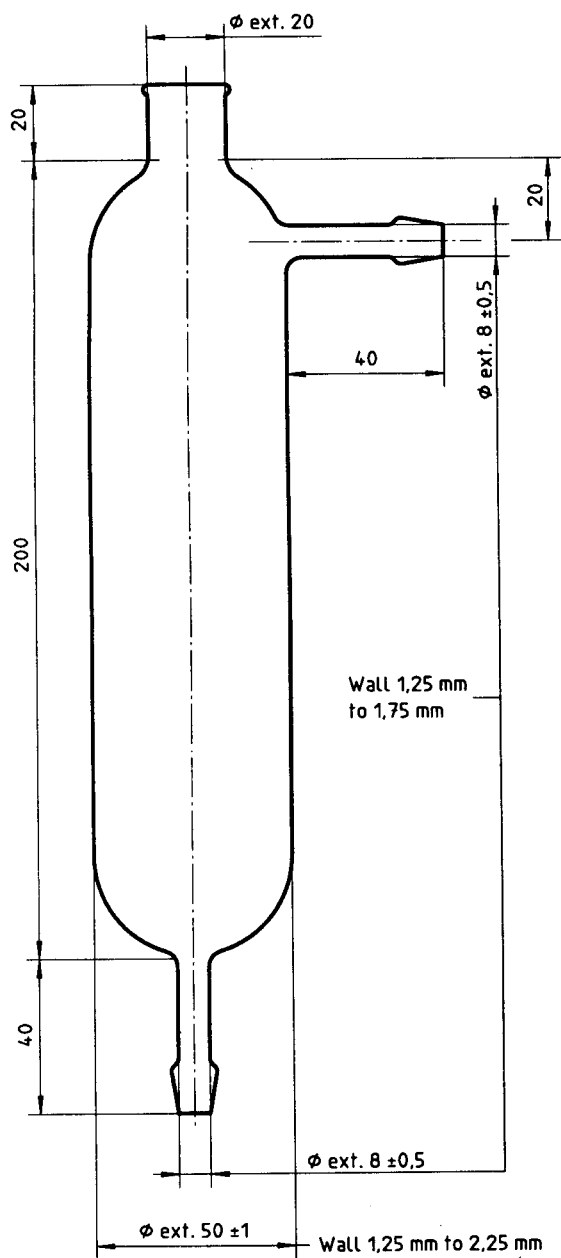


Figure 6 — Trap for the semi-micro method

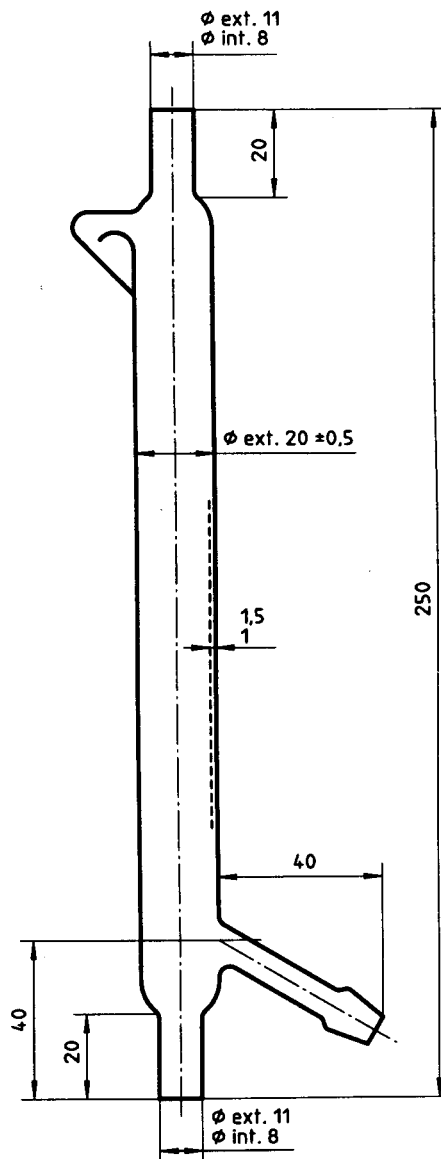


Figure 7 — Condenser jacket for the semi-micro method

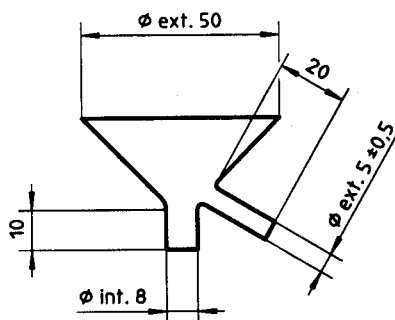


Figure 8 — Drip funnel for the semi-micro method

6) Where no tolerances are shown, normal working tolerances are allowed.

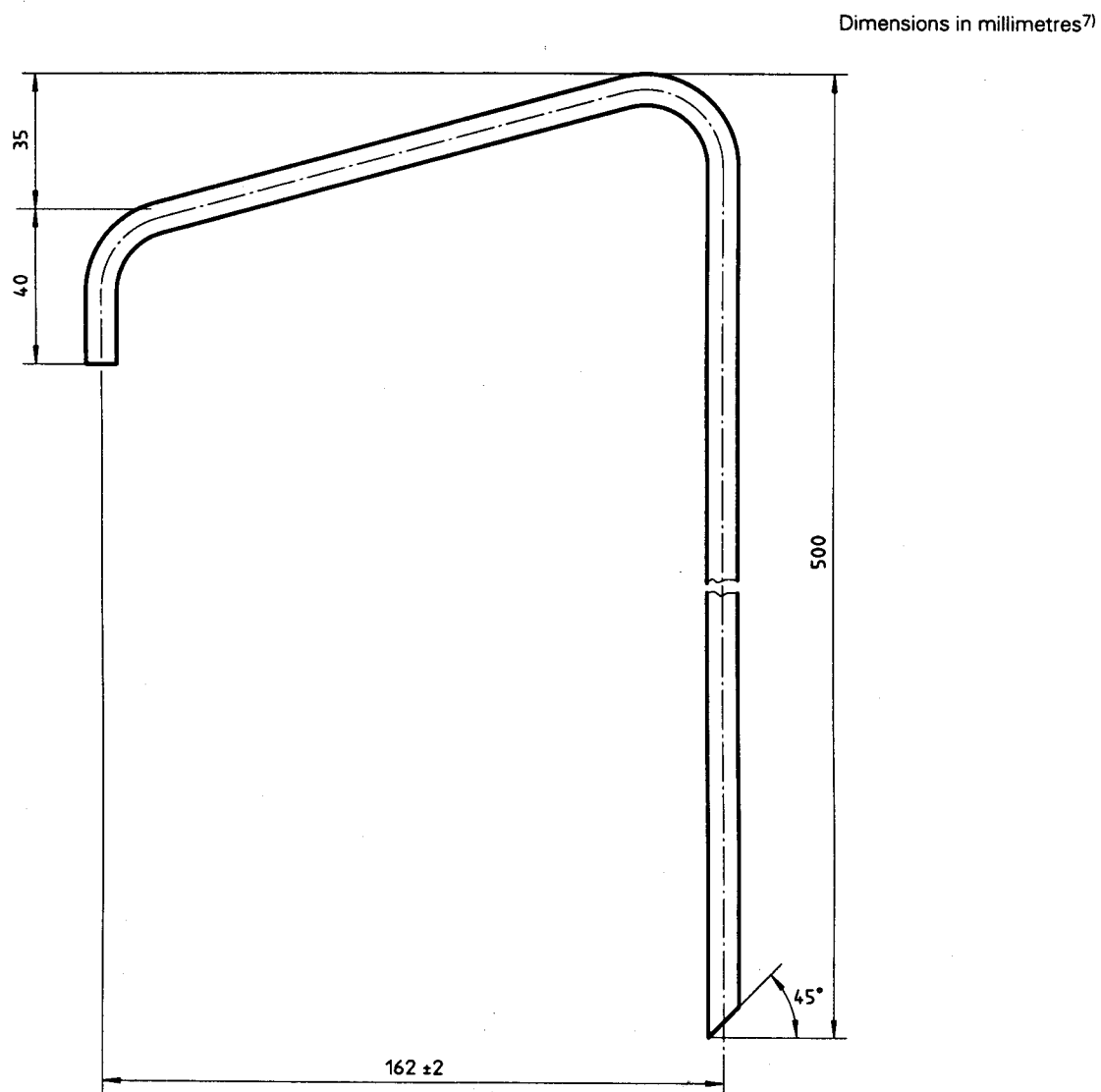


Figure 9 — Condenser tube for the semi-micro method

7) Where no tolerances are shown, normal working tolerances are allowed.

Annex A

(informative)

Guidance for using precision results

A.1 The general procedure for using precision results is as follows, with the symbol $|x_1 - x_2|$ designating a positive difference in any two measurement values (i.e. without regard to sign).

A.2 Enter the appropriate precision table (for whatever test parameter is being considered) at an average value (of the measured parameter) nearest to the "test" data average under consideration. This line will give the applicable r , (r), R or (R) for use in the decision process.

A.3 With these r and (r) values, the following general repeatability statements may be used to make decisions.

A.3.1 For an absolute difference: The difference $|x_1 - x_2|$ between two test (value) averages, found on nominally identical material samples under normal and correct operation of the test procedure, will exceed the tabulated repeatability r on average not more than once in twenty cases.

A.3.2 For a percentage difference between two test (value) averages: The percentage difference

$$[|x_1 - x_2| / (x_1 + x_2) / 2] \times 100$$

between two test values, found on nominally identical material samples under normal and correct operation of the test procedure, will exceed the tabulated repeatability (r) on average not more than once in twenty cases.

A.4 With these R and (R) values, the following general reproducibility statements may be used to make decisions.

A.4.1 For an absolute difference: The absolute difference $|x_1 - x_2|$ between two independently measured test (value) averages, found in two laboratories using normal and correct test procedures on nominally identical material samples, will exceed the tabulated reproducibility R not more than once in twenty cases.

A.4.2 For a percentage difference between two test (value) averages: The percentage difference

$$[|x_1 - x_2| / (x_1 + x_2) / 2] \times 100$$

between two independently measured test (value) averages, found in two laboratories using normal and correct test procedures on nominally identical material samples, will exceed the tabulated reproducibility (R) not more than once in twenty cases.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc : No. PCD 13 (2164).

| Amendments Issued Since Publication | | |
|-------------------------------------|---------------|---------------|
| Amend No. | Date of Issue | Text Affected |
| | | |
| | | |
| | | |
| | | |

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones : 2323 0131, 2323 3375, 2323 9402 Website : www.bis.org.in

Regional Offices :

| | | Telephones |
|----------|-----------------------------------------------------------------------------|------------------------------------------------|
| Central | : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002 | { 2323 7617 2323 3841 |
| Eastern | : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700 054 | { 2337 8499, 2337 8561 2337 8626, 2337 9120 |
| Northern | : SCO 335-336, Sector 34-A, CHANDIGARH 160 022 | { 260 3843 260 9285 |
| Southern | : C. I. T. Campus, IV Cross Road, CHENNAI 600 113 | { 2254 1216, 2254 1442 2254 2519, 2254 2315 |
| Western | : Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400 093 | { 2832 9295, 2832 7858 2832 7891, 2832 7892 |

Branches : AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE.
FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR.
LUCKNOW. NAGPUR. NALAGARH. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM.
VISAKHAPATNAM.